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(54) GEL-LIKE IONIC-CONDUCTION NATURE ELECTROLYTE, CELL AND ELECTROCHEMICAL DEVICE USING IT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a cell and an electrochemical device in which mechanical hardness excels, a form preservation nature to an external stress and a resistance to a temperature change and an ionic conductivity are excellent, the gel-like ionic conduction nature electrolyte can be formed in a short time, and it can be made to form a thin-film and can be formed of laminating, and a dimension accuracy of a package of it excels, and a simplification and making of lightweight are possible.

SOLUTION: It is (A) polyurethane containing carbonate group and (B) the gel-like ionic conductive electrolyte containing the electrolyte, and the electrochemical device and a cell using it.

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## CLAIMS

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[Claim(s)]

[Claim 1] (A) The gel ion conductivity electrolyte characterized by including the polyurethane and (B) electrolytic solution which have a carbonate radical.

[Claim 2] (A) The gel ion conductivity electrolyte according to claim 1 whose component is the compound which the compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical, and the compound which has at least two or more isocyanate radicals in intramolecular are made to react, and is obtained.

[Claim 3] The gel ion conductivity electrolyte according to claim 2 whose compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical is polycarbonate diol.

[Claim 4] (B) The gel ion conductivity electrolyte according to claim 1, 2, or 3 which is the electrolytic solution containing at least one or more sorts of electrolyte salts chosen from the group which a component becomes from  $\text{LiClO}_4$ ,  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ , and  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$ .

[Claim 5] (B) The gel ion conductivity electrolyte according to claim 1, 2, 3, or 4 which is the electrolytic solution containing at least one or more sorts of liquid

solvents chosen from the group which a component becomes from ethylene carbonate, propylene carbonate, gamma-butyrolactone, dimethyl carbonate, and diethyl carbonate.

[Claim 6] The gel ion conductivity electrolyte according to claim 1, 2, 3, 4, or 5 which comes to contain the photopolymerization nature compound which has one or more ethylene nature unsaturated bonds in intramolecular.

[Claim 7] The gel ion conductivity electrolyte according to claim 6 which comes to contain a photopolymerization initiator or a thermal polymerization initiator.

[Claim 8] The electrochemical device using a gel ion conductivity electrolyte according to claim 1, 2, 3, 4, 5, 6, or 7.

[Claim 9] The cell using a gel ion conductivity electrolyte according to claim 1, 2, 3, 4, 5, 6, or 7.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the cell and electrochemical device which used it for the gel ion conductivity electrolyte list.

[0002]

[Description of the Prior Art] since the high voltage beyond 3V is obtained and recent years and a lithium secondary battery are a light weight and high capacity -- electronic equipment, such as a cellular phone and a personal computer, -- use -- now, it is. The gestalt into which the electrolytic solution which melted the electrolyte salt to the nonaqueous organic solvent was infiltrated is used for the porosity macromolecule separator which has a through tube as an ionic migration object between a positive electrode and a negative electrode, and this lithium secondary battery is packed by the profound metal vessel in the whole cell structure in order to prevent exsorption of an electrolyte.

[0003] On the other hand, it is expected from thin-film-izing, laminating formation and simplification of a package, and lightweight-ization while the dependability of a cell and its safety improve, since the solid state battery which constituted the solid electrolyte as an ionic migration medium does not have a liquid spill. It is expected that the polyelectrolyte especially using an ion conductivity high molecular compound has desirable properties -- interface maintenance which followed in footsteps of the volume change by laminating structure formation with a cell and ion occlusion emission of an electrode can be performed since it has processing flexibility.

[0004] As an attempt of such a giant-molecule solid electrolyte, the electrolyte

salt complex of polyethylene oxide is British by P.V.Wright. Polymer Since it was reported to Journal7 and p319 (1975), the solid polymer electrolytes using a polyacrylonitrile, polyvinylidene fluoride, polyphosphazene, a polysiloxane, etc. including polyalkylene ether system ingredients, such as polyethylene glucanol and a polypropylene glycol, have been studied.

[0005] However, compared with the case where the electrolytic solution which consists of an organic solvent is used, a charge and discharge current consistency is limited and the cell constituted using the solid polymer electrolyte has technical problems, like electric capacity is small. It can be guessed that the reason is because it is large compared with the electrolytic solution with which the own bulk resistor of a giant-molecule solid electrolyte consists of an organic solvent and the interfacial resistance in the interface of a solid polymer electrolyte and an electrode material is large.

[0006] Therefore, the attempt which is going to raise ionic conductivity by making the condition more near the electrolytic solution form is proposed variously. For example, the thing which made the U.S. Pat. No. 5296318 specification contain a solvent in large quantities in a giant molecule has the in-between property of a liquid and a solid-state as a hybrid electrolyte, and it is indicated that high ionic conductivity can be obtained.

[0007] However, although the polyelectrolyte mentioned above was only able to

raise ionic conductivity, there was a problem that the configuration maintenance nature to external force, i.e., a mechanical strength, was spoiled.

[0008]

[Problem(s) to be Solved by the Invention] The purpose of this invention is to offer the gel ion conductivity electrolyte a mechanical strength excels [ electrolyte ] in the configuration maintenance nature to external force highly, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0009] Other purposes of this invention are to offer the gel ion conductivity electrolyte which is further excellent in a mechanical strength in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0010] Other purposes of this invention are to offer the gel ion conductivity electrolyte which is excellent in the resistance over a temperature change in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the



dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0011] Other purposes of this invention are to offer the gel ion conductivity electrolyte which is excellent in ion conductivity in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0012] Other purposes of this invention are to offer the gel ion conductivity electrolyte which is further excellent in ion conductivity in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0013] Other purposes of this invention are to offer the gel ion conductivity electrolyte which is further excellent in a mechanical strength in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0014] Other purposes of this invention are to offer the gel ion conductivity electrolyte which can be formed in a short time in addition to the above-mentioned effect of the invention, and thin-film-izing and laminating formation are possible for such an electrolyte, it is excellent in the dimensional accuracy of a package, and is used suitable for the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0015] Thin-film-izing and laminating formation using the gel ion conductivity electrolyte which can be formed in a short time are possible for other purposes of this invention, they are excellent in the dimensional accuracy of a package, and are to offer the cell and electrochemical device in which simplification and lightweight-izing are possible.

[0016]

[Means for Solving the Problem] This invention relates to the gel ion conductivity electrolyte characterized by including the polyurethane and (B) electrolytic solution which have (A) carbonate radical.

[0017] Moreover, this invention relates to the above-mentioned gel ion conductivity group electrolyte whose (A) component is the compound which the compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical, and the compound which has at least two or more isocyanate radicals in intramolecular are made to react, and is obtained.

[0018] Moreover, this invention relates to the above-mentioned gel ion conductivity group electrolyte whose compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical is polycarbonate diol.

[0019] Moreover, this invention relates to the above-mentioned gel ion conductivity electrolyte which is the electrolytic solution containing at least one or more sorts of electrolyte salts chosen from the group which the (B) component becomes from  $\text{LiClO}_4$ ,  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ , and  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$ .

[0020] Moreover, this invention relates to the above-mentioned gel ion conductivity electrolyte which is the electrolytic solution containing at least one or more sorts of liquid solvents chosen from the group which the (B) component becomes from ethylene carbonate, propylene carbonate, gamma-butyrolactone, dimethyl carbonate, and diethyl carbonate.

[0021] Moreover, this invention relates to the above-mentioned gel ion conductivity electrolyte which comes to contain the photopolymerization nature constituent which has one or more ethylene nature unsaturated bonds in intramolecular.

[0022] Moreover, this invention relates to the above-mentioned gel ion conductivity electrolyte which comes to contain a photopolymerization initiator or a thermal polymerization initiator.

[0023] Moreover, this invention relates to the cell and electrochemical device which used these gel ion conductivity electrolytes.

[0024]

[Embodiment of the Invention] Hereafter, this invention is explained to a detail.

[0025] The gel ion conductivity electrolyte of this invention consists of the electrolytic solution which is the polyurethane and the (B) component which have the carbonate radical which is the (A) component as a main constituent.

[0026] Although there will be especially no limit as polyurethane which has the carbonate radical which is the (A) component in this invention if obtained from composition of usual polyurethane, the compound obtained by the reaction of the compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical, for example, and the compound which has at least two or more isocyanates in intramolecular is used preferably.

[0027] As a compound which has at least two or more hydroxyl groups in the intramolecular in this invention, and has a carbonate radical Although there is especially no limit, polycarbonate diol is used preferably. For example, PLACCEL of Daicel Chemical Industries, Ltd. CD series is mentioned. CD-205, CD-208, CD-210, CD-220, CD-205PL, CD-208PL, CD-210PL, CD-220PL, CD-205HL, CD-208HL, CD-210HL, and CD-220HL are mentioned by a form and description.

[0028] Moreover, as a compound which has at least two or more isocyanate radicals in intramolecular, they are hexamethylene di-isocyanate, 2, 4-tolylene diisocyanate, methylenebis (4-phenyl isocyanate), xylylene diisocyanate, and 3-isocyanate methyl. - 3, 5, and 5-trimethyl cyclohexyl isocyanate etc. is mentioned.

[0029] Moreover, in case the compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical, and the compound which has at least two or more isocyanates in intramolecular are made to react, it can also be made to replace with and react to the compound which has at least two or more hydroxyl groups in intramolecular for some compounds which have at least two or more hydroxyl groups in intramolecular, and have a carbonate radical, and does not have a carbonate radical. As a compound which has at least two or more hydroxyl groups in intramolecular, and does not have a carbonate radical, ethylene glycol, diethylene-glycol, 1, and 2- or 1, 3-propylene glycol, 1, 3, -, 1, 4- or 2, 3-butanediol, 1,6-hexanediol, neopentyl glycol, a glycerol, trimethylol propane, etc. are mentioned. These blending ratio of coal is 0.1 - 5 % of the weight more preferably 0.1 to 10% of the weight to the compound which has at least two or more hydroxyl groups in intramolecular, and has a carbonate radical.

[0030] Metallic oxides, such as dilauric acid dibutyltin (II), octylic acid tin (II), and

naphthenic-acid lead, may be added as a catalyst to the reaction of a hydroxyl group and isocyanate.

[0031] moreover, to the gel ion conductivity electrolyte of this invention (A) Other resinous principles other than the polyurethane which has the carbonate radical which is a component may be mixed and used. For example, acrylic resin, an epoxy resin, phenoxy resin, a polyamide acid, Alkyd resin, polyethylene oxide, polypropylene oxide, And ion conductivity macromolecules, such as a copolymer of ethyleneoxide and propylene oxide, \*\*s, such as a copolymer of polyvinylidene fluoride, vinylidene fluoride, and hexafluoropropylene, a styrene butadiene system latex, a Teflon (trademark) system latex, and a polyacrylonitrile, are mentioned. these -- others -- as for the blending ratio of coal of resin, it is desirable to consider as the 10 - 100 weight section to the polyurethane 100 weight section which has the carbonate radical which is A component.

[0032] As for the weight average molecular weight of the polyurethane which has the carbonate radical of the (A) component of the gel ion conductivity electrolyte of this invention, 10,000-3,000,000 are desirable, and 11,000-2,000,000 are more desirable. Since crawling occurs [ weight average molecular weight ] less than in 10,000 at the time of spreading to an electrode and air bubbles enter, there is an inclination for membrane formation nature to get worse. Moreover,

when 3,000,000 is exceeded, coating nonuniformity occurs, thickness homogeneity gets worse, and there is an inclination for a good charge-and-discharge property to no longer be acquired.

[0033] (A) As for the amount of the polyurethane used which has the carbonate radical which is a component, it is desirable that it is 3 - 98 weight section to the total amount 100 weight section of (A) and (B), and it is more desirable that it is the range of 5 - 96 weight section. When there is an inclination for a membranous mechanical strength to become [ the amount used ] weak under in 3 weight sections and 98 weight sections are exceeded, ionic conductivity is not enough and there is an inclination for the charge-and-discharge capacity as a cell to fall.

[0034] The electrolytic solution which is the (B) component in this invention usually consists of a liquid solvent and an electrolyte salt. As a liquid solvent used for this invention, if chemically stable, there will be especially no limit. For example, water, a methanol, ethanol, propanol, isopropanol, Ethylene glycol, a diethylene glycol, triethylene glycol, Propylene glycol, dipropylene glycol, tripropylene glycol, Methyl cellosolve, ethylcellosolve, methyl carbitol, ethyl carbitol, Butyl carbitol, the triethylene glycol monomethyl ether, The triethylene glycol monobutyl ether, propylene glycol monomethyl ether, The propylene glycol monopropyl ether, dipropylene glycol monomethyl ether, Ethylene glycol

wood ether, ethylene glycol diethylether, Diethylene-glycol diethylether, diethylene-glycol ethyl methyl ether, A jig lime, a TORIGU lime, tetraethylene glycol wood ether, A tetrahydrofuran, wood ether, a trioxane, dioxane, Dimethoxyethane, polyethylene oxide, an acetone, a methyl ethyl ketone, Methyl acetate, ethylene carbonate, propylene carbonate, dimethyl carbonate, Diethyl carbonate, methylethyl carbonate, ethylene glycol monoethyl ether acetate, Ethylene glycol monomethyl ether acetate, diethylene-glycol diacetate, Organic solvents, such as lactone compounds, such as N.N-dimethylformamide, dimethylacetamide, dimethyl sulfoxide, N-methyl pyrrolidone, an acetonitrile, a butyrolactone, and PUROPIRO lactone, etc. are mentioned. From the standpoint of the solubility of an electrolyte salt, ethylene carbonate, propylene carbonate, gamma-butyrolactone, dimethyl carbonate, diethyl carbonate, etc. are desirable. These are independent or are used combining two or more kinds.

[0035] As an electrolyte salt used for this invention, an inorganic acid, an organic acid, mineral salt, organic salt, etc. are mentioned, for example. As the above-mentioned inorganic acid and mineral salt, the mineral salt which neutralizes inorganic acids, such as tetrafluoroboric acid, hexa fluorophosphoric acid, perchloric acid, a hexafluoro arsenic acid, a nitric acid, a sulfuric acid, a phosphoric acid, fluoric acid, a hydrochloric acid, a hydrobromic acid, and a hydroiodic acid, and these inorganic acids, and is acquired is mentioned, for



example. As the above-mentioned organic acid and organic salt, for example Trifluoro methansulfonic acid, A heptafluoro propyl sulfonic acid, bis(trifluoromethane sulfonyl) imido acid, An acetic acid, trifluoroacetic acid, a propionic acid, benzenesulfonic acid, toluenesulfonic acid, n-hexane sulfonic acid, n-octyl sulfonic acid, a dodecyl sulfonic acid, A cetyl sulfonic acid, 4-dodecylbenzenesulfonic acid, a camphor sulfonic acid, The Pori (vinyl) sulfonic acid, a dinonyl naphthalene sulfonic acid, a naphthalene sulfonic acid, p-chlorobenzene sulfonic acid, phenolsulfonic acid, a phenol disulfon acid, A trichlorobenzene sulfonic acid, a 4-nitrotoluene-2-sulfonic acid, Sulfonated polystyrene, sulfonation polyethylene, 2-sulfobenzonic acid, 3-nitrobenzene sulfonic acid, 4-octyl benzenesulfonic acid, 2-methyl-5-isopropyl benzenesulfonic acid, a sulfo succinic acid, The organic salt which neutralizes organic acids, such as a sulfo glutaric acid, a sulfo adipic acid, a sulfo pimelic acid, a sulfo suberic acid, a sulfo azelaic acid, a sulfo sebacic acid, and 2-sulfo-3-methylethyl dicarboxylic acid, and these organic acids, and is acquired is mentioned. These are independent or are used combining two or more kinds. Moreover, as a cation of salt type electrolyte salts, such as mineral salt and organic salt, alkali metal, alkaline earth metal, transition metals, a rare earth metal, etc. are mentioned, for example. These are independent or are used combining two or more kinds. When desirable classes differ depending on the

application to be used and it uses the gel ion conductivity electrolyte of this invention for a lithium cell, as for these cations, it is desirable to use lithium salt as an electrolyte salt to add. When using as a lithium cell especially, it is required to have a large potential window, stable lithium salt is electrochemically desirable as an electrolyte salt, for example, there are  $\text{LiClO}_4$ ,  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ ,  $\text{LiAsF}_6$ ,  $\text{LiCF}_3\text{SO}_3$ ,  $\text{LiC}_4\text{F}_9\text{SO}_3$ , and  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$ , and  $\text{LiClO}_4$ ,  $\text{LiBF}_4$ ,  $\text{LiPF}_6$ , and  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$  are more desirable.

[0036] (B) As for the concentration of an electrolyte salt, it is desirable that it is 0.1-15 mols/l. among the electrolytic solution which is a component, and it is more desirable that there are 0.1-5 mols/l.

[0037] (B) As for the amount of the electrolytic solution used which is a component, it is desirable that it is 98 - 3 weight section to the total amount 100 weight section of (A) and (B), and it is more desirable that it is 96 - 5 weight section. When under 3 weight sections are not enough as ion conductivity, there is an inclination for the charge-and-discharge capacity as a cell to fall and the amount used exceeds 98 weight sections, there is an inclination for the mechanical strength of a gel ion conductivity electrolyte to fall.

[0038] moreover, to the gel ion conductivity electrolyte of this invention The photopolymerization nature compound which has two or more ethylene nature unsaturated bonds in intramolecular may be blended. The compound which

adds alpha and beta-unsaturated carboxylic acid to polyhydric alcohol (what denaturalized by ethylene oxide and/or propylene oxide may be used), for example, and is obtained although there is especially no limit, For example, TORIMECHI roll pro pansy (meta) acrylate, ethylene oxide denaturation TORIMECHI roll pro pantry (meta) acrylate, Tetra-methylol METANTORI (meta) acrylate, tetramethylolmethane tetrapod (meta) acrylate, Dipentaerythritol PENTA (meta) acrylate, dipentaerythritol hexa (meta) acrylate, Pori ethylene glycol di(metha)acrylate, Pori propyleneglycol di(meth) acrylate, A 2 and 2-bis[4-(methacryloxydiethoxy or dipropoxy) phenyl] propane, A 2 and 2-bis[4-(meta-chestnut ROKISHI poly ethoxy \*\* is poly propoxy) phenyl] propane etc., The compound which adds alpha and beta-unsaturated carboxylic acid to a glycidyl group content compound, and is obtained, For example, a trimethylolpropane-triglycidyl-ether thoria chestnut rate, Bisphenol A diglycidyl ETERUJI (meta) acrylate etc., The matter which has polyvalent carboxylic acid, for example, phthalic anhydride etc., a hydroxyl group, and an ethylene nature partial saturation radical, The ester compound obtained from beta-hydroxyethyl (meta) acrylate etc. is used, and the URETANJI (meta) acrylate compound which had an urethane frame further can be used. For example, anyway What is necessary is just to carry out a polymerization with an optical exposure, electron beam irradiation, or heating.

[0039] the amount of the photopolymerization nature compound used which has two or more ethylene nature unsaturated bonds in intramolecular -- the total amount 100 weight section of (A) and (B) -- receiving -- 0 - 97 weight section -- it is preferably desirable 0 - 95 weight section and that it is the range of 3 - 93 weight section more preferably. If 97 weight sections are exceeded, the film will become weak, and there is an inclination for an electrode to short-circuit and for the cycle property of a cell to get worse among charge and discharge.

[0040] moreover, to the gel ion conductivity electrolyte of this invention of this invention Together with use of the photopolymerization nature constituent which has two or more ethylene nature unsaturated bonds in intramolecular, a photopolymerization initiator or a thermal polymerization initiator may be added.

As a photopolymerization initiator for example Benzophenone, N and N, N', and N'-tetramethyl (or tetraethyl) - 4 and 4'-diamino benzophenone, A 4-methoxy-4'-dimethylamino benzophenone, 2-ethyl anthraquinone, A phenanthrene quinone, 1-hydroxy cyclohexyl phenyl ketone, 2 and 2-dimethoxy -1, 2-bibenzyl-1-ON, 2-methyl-1-[4-(methylthio) phenyl]-2-morpholinopropanone -1, 2-benzyl-2-dimethylamino -1 -(4-morpholino phenyl)- Aromatic ketone of butanone-1 grade, The benzoin ether, such as benzoin methyl ether, benzoin ethyl ether, and benzoin phenyl ether, Benzoin, such as a methyl benzoin and an ethyl benzoin, other 2-(o-chlorophenyl)-4, 5-diphenyl imidazole dimer,

2-(o-chlorophenyl)-4, 5-JI (m-methoxypheny) imidazole dimer, 2, 4-JI (p-methoxypheny)-5-phenyl imidazole dimer, 2, and 4-diethylthio xanthone etc. is mentioned. Moreover, as a thermal polymerization initiator, well-known thermal polymerization catalysts, such as organic peroxide, such as diacyl peroxide, such as dialkyl (allyl compound) peroxide, such as a benzoyl peroxide and its derivative, a hydroperoxide and its derivative, cumyl peroxide, and its derivative, diacetyl peroxide, and its derivative, peroxy ketals, peroxy ester, and peroxy cull BONATO, or azobisisobutyronitril, and azobisiso valeronitrile, are mentioned, for example. These are one-kind independent, or two or more kinds can be mixed and they can be used. As for the amount of the photopolymerization initiator used, it is desirable that it is 0 - 15 weight section to the total amount 100 weight section of (A) and (B), it is more desirable that it is 0 - 12 weight section, and it is still more desirable that it is 0.01 - 12 weight section. When 15 weight sections are exceeded, the light absorption in the front face of an ingredient increases in the case of exposure, and there is an inclination for sufficient degree of hardness to no longer be obtained. As for the amount of the thermal polymerization initiator used, it is more desirable that it is 0 - 10 weight section preferably that it is 0 - 12 weight section to the total amount 100 weight section of (A) and (B), and it is still more desirable that it is 0.01 - 10 weight section. When the amount used exceeds 10 weight sections, there is an

inclination for electrolytic preservation stability to get worse.

[0041] Furthermore, the gel ion conductivity electrolyte of this invention may be made to contain coloring agents, such as pigments, such as colors, such as microparticulate bulking agents, such as an alumina, a silica, talc, and a barium sulfate, and Victoria pure blue, and Phthalocyanine Green.

[0042] the gel ion conductivity electrolyte of this invention -- the need -- responding -- an optical exposure and electron beam irradiation -- or you may make it heat and gel As an activity beam of light used in the case of exposure, a carbon arc lamp, an ultrahigh pressure mercury lamp, a high pressure mercury vapor lamp, a xenon lamp, metal halide, etc. are mentioned, for example. It is desirable that they are two or more 5 mJ/cm, as for light exposure, it is more desirable that they are two or more 15 mJ/cm, and it is desirable that they are especially two or more 25 mJ/cm. When light exposure is less than two 5 mJ/cm, photo-curing does not fully advance but there is an inclination for film reinforcement to fall. It is desirable that it is 20-250 degrees C, as for whenever [ stoving temperature ], it is more desirable that it is 30-200 degrees C, and it is desirable that it is especially 40-150 degrees C. When whenever [ stoving temperature ] is less than 20 degrees C, gelation does not fully advance but there is an inclination for film reinforcement to fall. Moreover, when whenever [ stoving temperature ] exceeds 250 degrees C, there is an inclination for the

liquid solvent in an electrolyte layer to volatilize and for ion conductivity to fall. As for heating time, it is desirable to carry out for 5 - 90 minutes preferably for [ 5 seconds - ] 120 minutes. When heating time is less than 5 seconds, gelation does not fully advance but there is an inclination for film reinforcement to fall. Moreover, when heating time exceeds 120 minutes, there is an inclination for the liquid solvent in an electrolyte layer to volatilize and for ion conductivity to fall. Anyway, heating conditions can be adjusted from thermosetting, the insolubility by heat, the volatility of a liquid solvent, film reinforcement, and ion conductivity balance.

[0043] It is desirable to make the gel ion conductivity electrolyte of this invention carry out 0.001-40 weight section content of the antioxidants, such as adhesion grant agents, such as heat cross linking agents, such as plasticizers, such as dibutyl phthalate and diethyl phthalate, and bismaleimide, a heat coloring inhibitor, a phosphoric ester system flame retarder, a stabilizer, and benzotriazol, a leveling agent of a silicon system, and a benzoquinone, etc. to the total amount 100 weight section of a gel ion conductivity electrolyte if needed.

[0044] When forming an electrolyte layer with the gel ion conductivity electrolyte of this invention, although it changes with applications, it is desirable that it is 1-1000 micrometers, as for the thickness, it is more desirable that it is 2-500 micrometers, and it is desirable [ thickness ] that it is especially 3-300

micrometers. There is an inclination which is not enough as the charge-and-discharge property of the produced cell.

[0045] It is desirable that they are  $10^{-7}$  -  $10^{-2}$  S/cm, as for the ion conductivity of the electrolyte in this invention, it is more desirable that it is  $10^{-6}$  -  $9 \times 10^{-3}$  S/cm, and it is desirable that it is especially  $10^{-5}$  -  $8 \times 10^{-3}$  S/cm.

[0046] The cell using the gel ion conductivity electrolyte of this invention consists of that a positive electrode and a negative electrode join through said gel ion conductivity electrolyte. When the above-mentioned cell is a lithium cell, it is desirable that lithium salt contains in an electrolyte. Under the present circumstances, the matter in which occlusion emission of a lithium is possible as the positive electrode and negative electrode of a cell is used. Although you may use by independent [ its ] in order that there may be no limit and an electronic conduction nature high-molecular-compound part may work as a positive-active-material ingredient, especially if it is the ingredient which has high potential to a negative electrode as the above-mentioned positive electrode, the positive-electrode ingredient shown below may be used together. As the above-mentioned positive-electrode ingredient, they are  $\text{Li}_{1-x}\text{CoO}_2$ ,  $\text{Li}_{1-x}\text{NiO}_2$ ,  $\text{Li}_{1-x}\text{Mn}_2\text{O}_4$ , and  $\text{Li}_{1-x}\text{MO}_2$  (it Co(es)  $0 < x < 1$  and M), for example. Complex, such as nickel, Mn, and Fe,  $\text{Li}_{2-y}\text{Mn}_2\text{O}_4$  ( $0 < y < 2$ ),  $\text{Li}_{1-x}\text{V}_2\text{O}_5$  ( $0 < x < 1$ ),  $\text{Li}_{2-y}\text{V}_2\text{O}_5$  ( $0 < y < 2$ ), Organic compounds, such as metal chalcogenide, such as oxides,



such as  $\text{Li}_{1-x}\text{Nb}_2\text{O}_5$  ( $0 < x < 1.2$ ),  $\text{Li}_{1-x}\text{TiS}_2$ ,  $\text{Li}_{1-x}\text{MoS}_2$ , and  $\text{Li}_{1-z}\text{NbSe}_3$  ( $0 < z < 3$ ); a dithiol derivative, and a disulfide derivative, etc. are mentioned. The ingredient which has low potential to the above-mentioned positive electrode as the above-mentioned negative electrode can be used. For example, metal lithiums, such as a metal lithium, an aluminum lithium alloy, and a magnesium aluminum lithium alloy,  $\text{AlSb}$ ,  $\text{Mg}_2\text{germanium}$ , the intermetallic compound of  $\text{NiSi}_2$  grade, graphite, carbon system ingredients, such as corks and a low-temperature baking macromolecule, and a  $\text{SnM}'$  system oxide ( $\text{M}' - \text{Si} -$ ) germanium,  $\text{Pb}$ , etc. are shown --  $\text{Si}_{1-y}\text{M}''\text{yOz}$  (it  $\text{Pb(s)} \text{M}'' - \text{W}$  and  $\text{Sn} -$ ) The lithium solid solution of metallic oxides, such as a multiple oxide, like  $\text{B}$  etc. is shown, titanium oxide, and ferrous oxide, Ceramics, such as a nitride of  $\text{Li}_7\text{MnN}_4$ ,  $\text{Li}_3\text{FeN}_4$ ,  $\text{Li}_{3-x}\text{Co}_x\text{N}$ ,  $\text{Li}_{3-x}\text{Ni}_x\text{N}$ ,  $\text{Li}_{3-x}\text{Co}_x\text{N}$ ,  $\text{Li}_{3-x}\text{Cu}_x\text{N}$ ,  $\text{Li}_3\text{BN}_2$ ,  $\text{Li}_3\text{AlN}_2$ , and  $\text{Li}_3\text{SiN}_3$  grade, etc. is mentioned. In addition, when returning a lithium ion with a negative electrode and using as a metal lithium, since what is necessary is just the ingredient which has electronic conduction nature, above, it is not limited. As for the above-mentioned positive electrode and a negative electrode, it is desirable to carry out fabrication of the above-mentioned ingredient to a predetermined configuration, and a continuum, the binder dispersing element of a powder ingredient, etc. are mentioned as a configuration of an electrode, for example. the above -- as the fabrication approach of a

continuum, the fabrication approaches, such as electrolysis, vacuum evaporation, sputtering, CVD, melting processing, sintering, and compression, are mentioned, for example. Moreover, as the fabrication approach of the binder dispersing element of a powder ingredient, the fabrication approach which mixes and fabricates a powder-like electrode material with a binder is mentioned, for example. As the above-mentioned binder ingredient, non-ion conductivity giant molecules, such as ion conductivity giant molecules, such as polyvinylidene fluoride, a styrene butadiene system latex, and a Teflon system latex, KF1000 by Kureha Chemical Industry Co., Ltd., etc. are used, for example. Moreover, it adds and a polymerization nature monomer and a cross linking agent are made also as for a polymerization and the thing which you also make construct a bridge to the fabrication backward. Furthermore, radiant energies, such as an electron ray, a gamma ray, and ultraviolet rays, can also be irradiated from standpoints, such as improvement in on the strength of a binder, and denaturation. Moreover, in order to perform the electronic transition of a positive electrode and a negative-electrode ingredient, a charge collector can be formed in an electrode with an ingredient with low electric resistance, for example, by using a charge collector as a substrate, it can fabricate by the above-mentioned fabrication approach, and can consider as an electrode.

[0047] The configuration of a cell can be made into structures, such as the shape

of the shape of a sheet, and a roll, by making into a unit the positive electrode / electrolyte membrane / negative electrode which has the structure which the positive electrode and the negative electrode joined through the electrolyte membrane, for example, carried out the laminating of the film-like component one by one, and the gestalt of a cell may be a gestalt of arbitration, such as a coin mold, a sheet or a film mold, cylindrical, and a square shape. For example, a thin cell with flexibility can be manufactured by putting and carrying out the seal of the layered product which consists of a positive electrode / an electrolyte membrane / a negative electrode with the aluminum laminate material which consists of polypropylene / denaturation polypropylene / aluminum as a sheathing object. Moreover, the thing which connected the electrodes of a cell unit to juxtaposition or a serial and which it constructs and is considered as a cell is also possible. It has the description to which an electrical potential difference can be made to increase with the number of series connection especially.

[0048] The gel ion conductivity electrolyte of this invention can be used for an electrochemical device. If the above-mentioned electrochemical device carries out energy for are recording, increase and decrease, emission, etc. by electrochemical change, there will be especially no limit and electrochemical devices, such as cells, such as a lithium cell, a nickel hydride battery, and a fuel cell, and an electrochemistry sensor, etc. will be mentioned. Moreover, since the

gel ion conductivity electrolyte of this invention discovers the color tone change by the potential difference, it is [ whenever / room air temperature ] applicable to photoelectricity chemical devices, such as modulated light ingredients, such as modulated light glass for adjustment, and a record ingredient, the device adapting these, etc.

[0049]

[Example] Hereafter, although an example explains this invention, this invention is not limited to this.

[0050] 1l. of dimethylformamides distilled as 1,4-butanediol 0.9g, polycarbonate diol (PLACCEL CD-220) 39.6g, and a reaction solvent was put into the 3l. 4 opening flask which attached the reflux cooler which synthetic example 1 agitator, a thermometer, nitrogen installation tubing, and a calcium chloride dry pipe attached. After fully carrying out the nitrogen purge, nitrogen installation tubing was removed, and it changed for the tap funnel which attached the dry pipe, and hexamethylene di-isocyanate 5g was put into this. When it heated with scrambling and reflux started, the moiety of tap funnel contents was added at once, and was stirred violently. The remainder was dropped over 3 hours, flowed back for further 1 hour, and was cooled to the room temperature. Methanol 3000g was poured into the obtained resin solution, and resin solid content was settled. After washing several times with a methanol furthermore, stoving was

carried out at 100 degrees C for 8 hours.

[0051] 1l. of dimethylformamides distilled as 1,4-butanediol 1.1g, polycarbonate diol (PLACCEL CD-220PL) 39.6g, and a reaction solvent was put into the 3l. 4 opening flask which attached the reflux cooler which synthetic example 2 agitator, a thermometer, nitrogen installation tubing, and a calcium chloride dry pipe attached. After fully carrying out the nitrogen purge, nitrogen installation tubing was removed, and it changed for the tap funnel which attached the dry pipe, and methylenebis (4-phenyl isocyanate) 7.5g and distilled dimethylformamide 100ml were put into this. When it heated with scrambling and reflux started, the moiety of tap funnel contents was added at once, and was stirred violently. The remainder was dropped over 3 hours, flowed back for further 1 hour, and was cooled to the room temperature. Methanol 3000g was poured into the obtained resin solution, and resin solid content was settled. After washing several times with a methanol furthermore, stoving was carried out at 100 degrees C for 8 hours.

[0052] 1l. of dimethylformamides distilled as 1,4-butanediol 2.68g and a reaction solvent was put into the 3l. 4 opening flask which attached the reflux cooler which synthetic example 3 agitator, a thermometer, nitrogen installation tubing, and a calcium chloride dry pipe attached. After fully carrying out the nitrogen purge, nitrogen installation tubing was removed, and it changed for the tap

funnel which attached the dry pipe, and hexamethylene di-isocyanate 5g was put into this. When it heated with scrambling and reflux started, the moiety of tap funnel contents was added at once, and was stirred violently. The remainder was dropped over 3 hours, flowed back for further 1 hour, and was cooled to the room temperature. Methanol 3000g was poured into the obtained resin solution, and resin solid content was settled. After washing several times with a methanol furthermore, stoving was carried out at 100 degrees C for 8 hours.

[0053] 1l. of dimethylformamides distilled as 1,4-butanediol 2.9g and a reaction solvent was put into the 3l. 4 opening flask which attached the reflux cooler which synthetic example 4 agitator, a thermometer, nitrogen installation tubing, and a calcium chloride dry pipe attached. After fully carrying out the nitrogen purge, nitrogen installation tubing was removed, and it changed for the tap funnel which attached the dry pipe, and methylenebis (4-phenyl isocyanate) 7.5g and distilled dimethylformamide 100mL were put into this. When it heated with scrambling and reflux started, the moiety of tap funnel contents was added at once, and was stirred violently. The remainder was dropped over 3 hours, flowed back for further 1 hour, and was cooled to the room temperature. Methanol 3000g was poured into the obtained resin solution, and resin solid content was settled. After washing several times with a methanol furthermore, stoving was carried out at 100 degrees C for 8 hours.

[0054] The production approach cel seed (cobalt acid lithium by Nippon Chemical Industrial Co., Ltd.) of positive-electrode material, and LB270 (graphite by the Japanese graphite company) and KF1120 (polyvinylidene fluoride by Kureha Chemical Industry Co., Ltd.) were mixed at a rate of 80:10:10 volume %, injection mixing was carried out at the N-methyl-2-pyrrolidone, and the slurry-like solution was produced. This solution was applied to aluminium foil with a thickness of 20 micrometers, and it dried to it. a mixture -- coverage was 289 g/m<sup>2</sup>. a mixture -- it pressed so that bulk density might become 3.6 g/cm<sup>3</sup>, and it cut to 1cmx1cm, and the positive electrode was produced.

[0055] Production approach carbo TRON PE (amorphous carbon by Kureha Chemical Industry Co., Ltd.) and KF1120 (polyvinylidene fluoride by Kureha Chemical Industry Co., Ltd.) of negative-electrode material was mixed at a rate of 90:10 volume %, injection mixing was carried out at the N-methyl-2-pyrrolidone, and the slurry-like solution was produced. This solution was applied to copper foil with a thickness of 20 micrometers, and it dried to it. a mixture -- coverage was 98 g/m<sup>2</sup>. a mixture -- it pressed so that bulk density might become 1.1 g/cm<sup>3</sup>, and it cut to 1cmx1cm, and the negative electrode was produced.

[0056] All evaluations of preparation of an ingredient, the ionic conductivity in 25 degrees C, initial discharge capacity, and a cycle property were performed in the

glove compartment under argon atmosphere.

[0057] On the 25-micrometer polyethylene terephthalate film of thickness, the resin solution 1 shown in Table 1 containing the resin obtained in the example 1 of example 1 composition was applied to homogeneity, and carried out stoving for 15 minutes 80 degrees C among the dryer. Next, it exposed so that light exposure might serve as 1 J/cm<sup>2</sup> with an extra-high pressure mercury lamp (SX-UI250 by USHIO, INC. HQ). The thickness of the resin film was about 60 micrometers. Furthermore, after removing the obtained resin film from the polyethylene terephthalate film and carrying out a vacuum drying for 120 minutes at 80 degrees C, it was left in the glove compartment under argon atmosphere for 1 hour. Next, it is 1M in a glove compartment about the obtained resin film. It was immersed in the ethyl carbonate and the dimethyl carbonate (dimethyl-carbonate =1 [ ethyl carbonate / //] 1: volume ratio) solution of LiBF<sub>4</sub> for 90 minutes at 25 degrees C, and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 1 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial



discharge capacity and a cycle property is shown in Table 2.

[0058] On the glass plate with a thickness of 1.5mm, the resin solution 2 shown in Table 1 containing the resin obtained in the example 2 of example 2 composition was \*\*\*\*\* carried out, and was put with another glass plate through the silicone rubber spacer with a thickness of 0.5mm. Next, it exposed so that light exposure might serve as 1 J/cm<sup>2</sup> with an extra-high pressure mercury lamp (SX-UI250 by USHIO, INC. HQ), and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 2 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial discharge capacity and a cycle property is shown in Table 2.

[0059] The resin solution 3 shown in Table 1 containing the resin obtained in the example 1 of example 3 composition was applied to homogeneity on the 25-micrometer polyethylene terephthalate film of thickness, and heating of for 80 degrees C in a dryer / 15 minutes, and a 20-minute 100 degrees C / between performed desiccation and a heat-curing reaction. Next, the thickness of the resin film was about 65 micrometers. Furthermore, after removing the obtained

resin film from the polyethylene terephthalate film and carrying out a vacuum drying for 120 minutes at 80 degrees C, it was left in the glove compartment under argon atmosphere for 1 hour. Next, it is 1M in a glove compartment about the obtained resin film. It was immersed in the ethyl carbonate and the dimethyl carbonate (dimethyl-carbonate =1 [ ethyl carbonate / //] 1: volume ratio) solution of LiPF<sub>6</sub> for 60 minutes at 25 degrees C, and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 3 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial discharge capacity and a cycle property is shown in Table 2.

[0060] The resin solution 4 shown in Table 1 containing the resin obtained in the example 1 of example 4 composition was applied to homogeneity on the 25-micrometer polyethylene terephthalate film of thickness, and desiccation by heating of for 80 degrees C in a dryer / 20 minutes, and a 20-minute 150 degrees C / between was performed. The thickness of the resin film was about 80 micrometers. Furthermore, after removing the obtained resin film from the polyethylene terephthalate film and carrying out a vacuum drying for 120

minutes at 80 degrees C, it was left in the glove compartment under argon atmosphere for 1 hour. Next, it is 1M in a glove compartment about the obtained resin film. It was immersed in the gamma-butyrolactone solution of LiPF<sub>6</sub> for 70 minutes at 25 degrees C, and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 4 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial discharge capacity and a cycle property is shown in Table 2.

[0061] The resin solution 5 shown in Table 1 containing the resin obtained in the example 1 of example 5 composition was applied to homogeneity on the 25-micrometer polyethylene terephthalate film of thickness, and desiccation by heating of for 80 degrees C in a dryer / 10 minutes, and a 20-minute 150 degrees C / between was performed. The thickness of the resin film was about 80 micrometers. Furthermore, after removing the obtained resin film from the polyethylene terephthalate film and carrying out a vacuum drying for 120 minutes at 80 degrees C, it was left in the glove compartment under argon atmosphere for 1 hour. Next, it is 1M in a glove compartment about the obtained

resin film. It was immersed in the gamma-butyrolactone solution of LiBF<sub>4</sub> for 80 minutes at 25 degrees C, and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 5 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial discharge capacity and a cycle property is shown in Table 2.

[0062] Example 6 Aldrich reagent resin ((Reagent No.:41833-1)) [ Copolymer ] of poly 1 and 6-hexyl-1 -- 2-ethylcarbonatediol 4 and 4'-methylenebis-(phenylisocyanate) and Carry out the dimethylformamide dissolution and a resin solution is produced so that 1 and 4-butanediol may become 20% in the amount of solid content. It applied to homogeneity on the 50-micrometer polyethylene terephthalate film of thickness, and desiccation by heating of for 80 degrees C in a dryer / 15 minutes, and a 20-minute 150 degrees C / between was performed. The thickness of the resin film was about 100 micrometers. Furthermore, after removing the obtained resin film from the polyethylene terephthalate film and carrying out a vacuum drying for 120 minutes at 80 degrees C, it was left in the glove compartment under argon atmosphere for 1 hour. Next, it is 1M in a glove

compartment about the obtained resin film. It was immersed in the ethyl carbonate and the dimethyl carbonate (dimethyl-carbonate =1 [ ethyl carbonate / //] 1: volume ratio) solution of LiPF<sub>6</sub> for 80 minutes at 25 degrees C, and the gel ion conductivity electrolyte was obtained. The result of having evaluated the mechanical strength of the gel ion conductivity electrolyte by the acquired example 6 and the ionic conductivity in 25 degrees C is shown in Table 2. Moreover, the obtained gel ion conductivity electrolyte was fixed by superposition and the pressure of 1.1kg/cm<sup>2</sup> with the above-mentioned positive electrode and the negative electrode, and it considered as the electrochemistry cel. The result of having evaluated initial discharge capacity and a cycle property is shown in Table 2.

[0063] The gel ion conductivity electrolyte obtained in the example 7 example 1 was put with the above-mentioned positive electrode and the lithium foil, and it fixed by the pressure of 1.0kg/cm<sup>2</sup>, and considered as the electrochemistry cel. Next, lead wire was taken with copper wire from the aluminates section and the negative-electrode lithium of positive-electrode material, the electrochemistry cel obtained with the aluminum laminate material which consists of polypropylene / denaturation polypropylene / aluminates was put, the seal was carried out by 90 degrees C and the pressure of 1.0kg/cm<sup>2</sup>, and the aluminum lamination cell was obtained. The result of having evaluated the discharge capacity by the acquired

example 7 and a cycle property is shown in Table 2.

[0064] It carried out by the same approach as an example 1 except using the resin solution 6 shown in Table 1 produced in the example 3 of example of comparison 1 composition.

[0065] It carried out by the same approach as an example 1 except using the resin solution 7 shown in Table 1 produced in the example 4 of example of comparison 2 composition.

[0066] A mechanical strength, the ionic conductivity in 25 degrees C, initial discharge capacity, and a cycle property were evaluated about the evaluation cell using the electrolyte and it which were produced in the example and the example of a comparison. Each evaluation approach is shown below.

:O which evaluated the condition when bending [mechanical-strength] 2cmx2cm and a gel ion conductivity electrolyte with a thickness of 500 micrometers as follows ... Even if it bends 180 degrees, a crack is not produced but it has the elasticity which returns a configuration.

x ... Even if it bends 45 degrees, a crack is not produced, but it will be divided if it bends more than it.

The [ionic conductivity in 25 degrees C] gel ion conductivity electrolyte was put with the Indanthrene loess plate, the cel for measurement was produced, and it carried out using the alternating current impedance method which impresses an

alternating current to inter-electrode [ of the cel for measurement obtained in 25 degrees C ], and measures a resistance component, and calculated from the real number impedance intercept of a Cole Cole plot.

[Initial discharge capacity] The time of 3.5V and discharge performed charge-and-discharge characterization using the toss cat by TOYO SYSTEM Co., Ltd. 3100A system using the electrochemistry cel obtained in 25 degrees C on the conditions whose cut-off voltage are current density 0.02 mA-cm<sup>2</sup>, and is 2.0V at the time of charge, and calculated discharge capacity.

It carried out by having repeated the [cycle property] above-mentioned charge and discharge, and expressed with the number of cycles from which an early discharge capacity became 70%.

[0067] When characterization was performed from Table 2 using the gel ion conductivity electrolyte which becomes this invention (an example 1 - example 6), it turned out that it excels in a mechanical strength and a cycle property improves compared with the case (the example 1 of a comparison - example 2 of a comparison) where made the gel ion conductivity electrolyte form by the approach of this invention out of range, and characterization is performed. Moreover, the electrochemistry cel used in the examples 1-5 was excellent in 25-degree C ion conductivity and initial discharge capacity, and was best electrochemistry cel. Moreover, the cell produced in the example 7 was excellent

in initial discharge capacity and a cycle property, and was a good cell.

[0068]

[Table 1]

材料		樹脂溶液						
		1	2	3	4	5	6	7
(A) 成分	合成例1で作製した樹脂	1	—	1	1	1	—	—
	合成例2で作製した樹脂	—	1	—	—	—	—	—
	合成例3で作製した樹脂	—	—	—	—	—	1	—
	合成例4で作製した樹脂	—	—	—	—	—	—	1
(B) 成分	1M LiBF <sub>4</sub> のγ-ブチロラクトン溶液	—	6	—	—	—	—	6
光重合性組成物	BPE-200(新中村化学工業社製E0変性ビスフェノールAジメタクリレートの商品名)	0.5	—	0.5	0.5	—	0.5	—
	APG-400(新中村化学工業社製ポリプロピレングリコール400ジメタクリレートの商品名)	—	0.3	—	—	—	—	0.3
光重合開始剤	KAYACURE BP(ベンゾフェノン、日本化薬社製)	0.03	0.03	—	—	—	0.03	0.03
	EAB(4,4'-ビス(2-エチルアミノ)ベンゾフェノン、和光純薬社製)	0.001	0.001	—	—	—	0.001	0.001
熱重合開始剤	パーヘキシン 25B (日本油脂社製)	—	—	0.01	—	—	—	—
無機充填剤	AEROSIL50 (日本アエロジル社製シリカ微粉末)	2	—	—	—	—	—	2
	AL160SG3 (昭和電工社製アルミナ微粉末)	—	6	—	—	—	—	—
有機溶剤	アセトニトリル	5.5	—	5.5	5.5	5.5	5.5	—

(表中の数字は (A) 成分を1とした重量比を示す。)



[0069]

[Table 2]

項目	実施例							比較例	
	1	2	3	4	5	6	7	1	2
樹脂溶液	樹脂溶液 1	樹脂溶液 2	樹脂溶液 3	樹脂溶液 4	樹脂溶液 5	—	—	樹脂溶液 6	樹脂溶液 7
機械的強度	○	○	○	○	○	○	—	×	×
イオン伝導率 (S/cm)	$9 \times 10^{-4}$	$1 \times 10^{-3}$	$1 \times 10^{-3}$	$7 \times 10^{-4}$	$1 \times 10^{-3}$	$1 \times 10^{-3}$	—	$1 \times 10^{-3}$	$1 \times 10^{-3}$
初期放電容量 (mAh)	2.9	2.7	2.8	2.0	2.7	2.6	2.6	2.1	2.7
サイクル特性 (回)	180	100	50	85	120	120	120	6	5

[0070]

[Effect of the Invention] The gel ion conductivity electrolyte a mechanical strength excels [ electrolyte ] in the configuration maintenance nature to external force highly by this invention was obtained. Moreover, thin-film-izing and laminating formation are possible, the cell and electrochemical device using a gel ion conductivity electrolyte of this invention are excellent in the dimensional accuracy of a package, and simplification and lightweight-izing are possible for them.